(12) UK Patent Application (19) GB (11) 2 367 454 (13) A

(43) Date of A Publication 03.04.2002

(21) Application No 0023657.0

(22) Date of Filing 27.09.2000

(51) INT CL[7]
H04Q 7/38

(52) UK CL (Edition T)
H4L LRPLR L213

(56) Documents Cited
WO 00/21319 A1

(58) Field of Search
UK CL (Edition S) H4L LDLS LRPLR
INT CL[7] H04Q 7/38
On-Line - EPODOC, JAPIO, WPI

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(54) Abstract Title
Location area and routing area update signalling in a cellular communications system

(57) A method for Combined Location Area (LA) / Routing Area (RA) Update message signalling in GPRS and UMTS cellular communications systems utilizes a Combined Update RA/LA message 1a containing information of new Location Area Identity (LAI), International Mobile Station Identity (IMSI), Serving GPRS Service Node (SGSN) Number, Location Update Type, and new VLR; and an Insert Subscriber Data message 1d containing information of new LAI, IMSI, SGSN Number; and Location Update Type. This produces a more efficient and secure signalling procedure, which allows the Combined LA/RA Update to occur in parallel, and reduces the number of signalling messages required. Additionally, an Insert Subscriber Data Acknowledge message 1e may contain information of VLR TMSI (Temporary Mobile Station Identity), allowing another message to be saved.

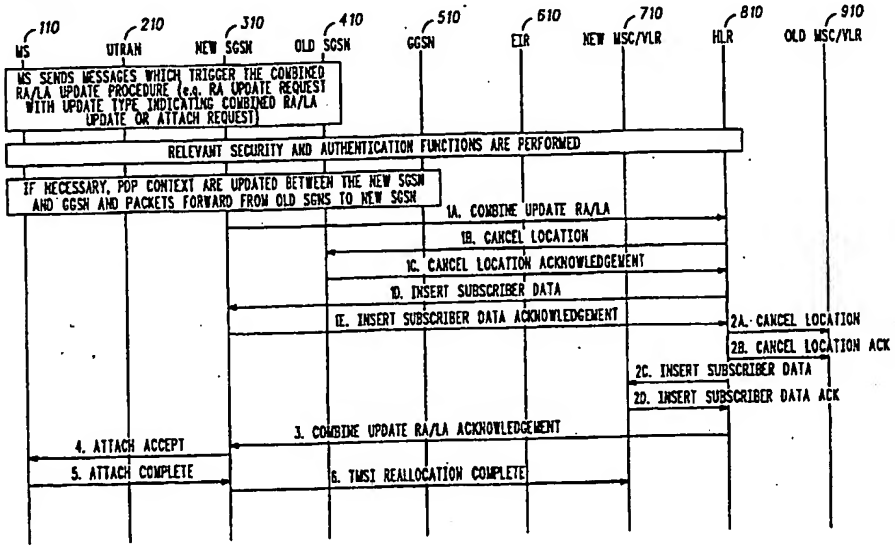

FIG. 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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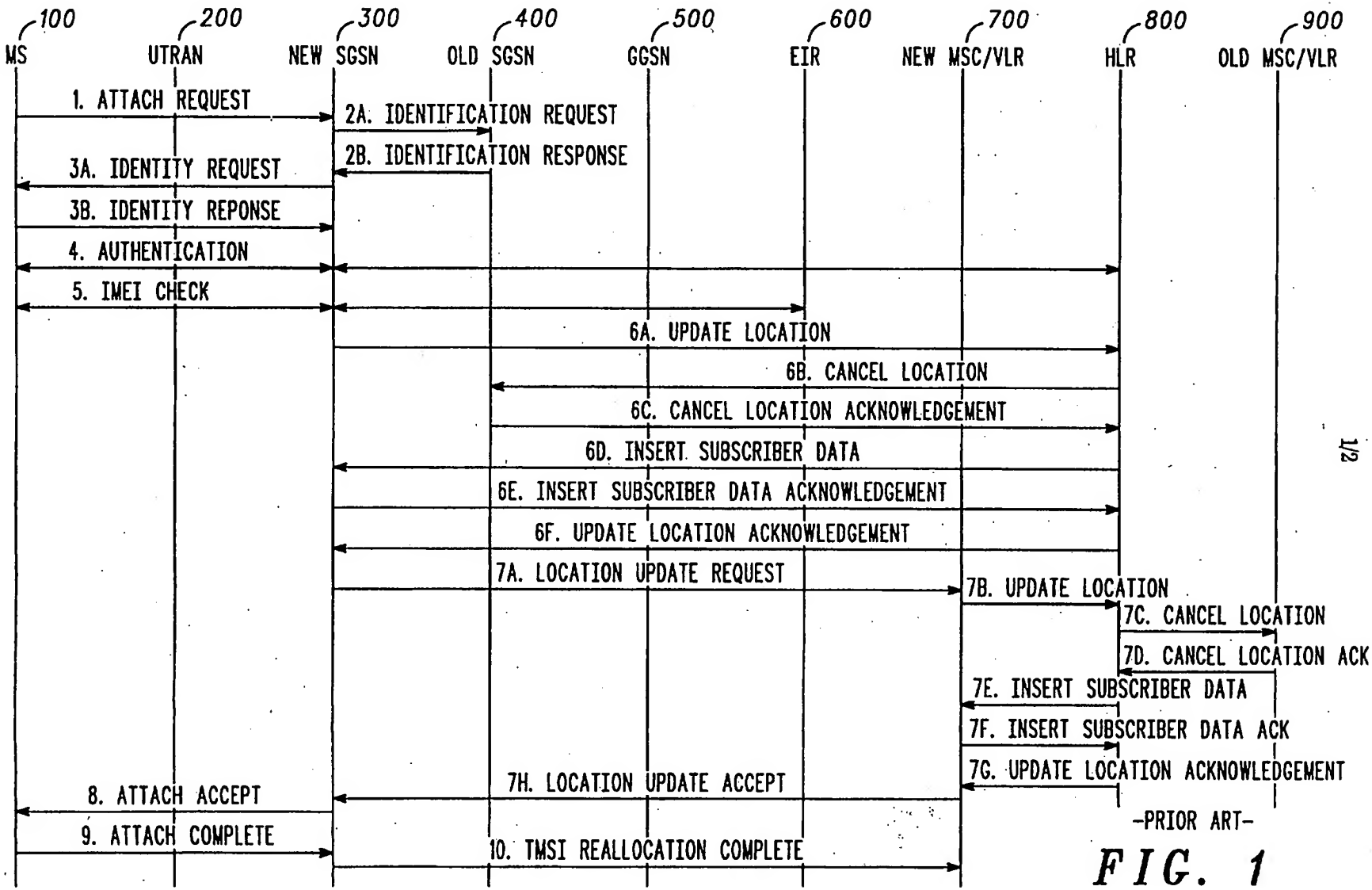

-PRIOR ART-

FIG. 1

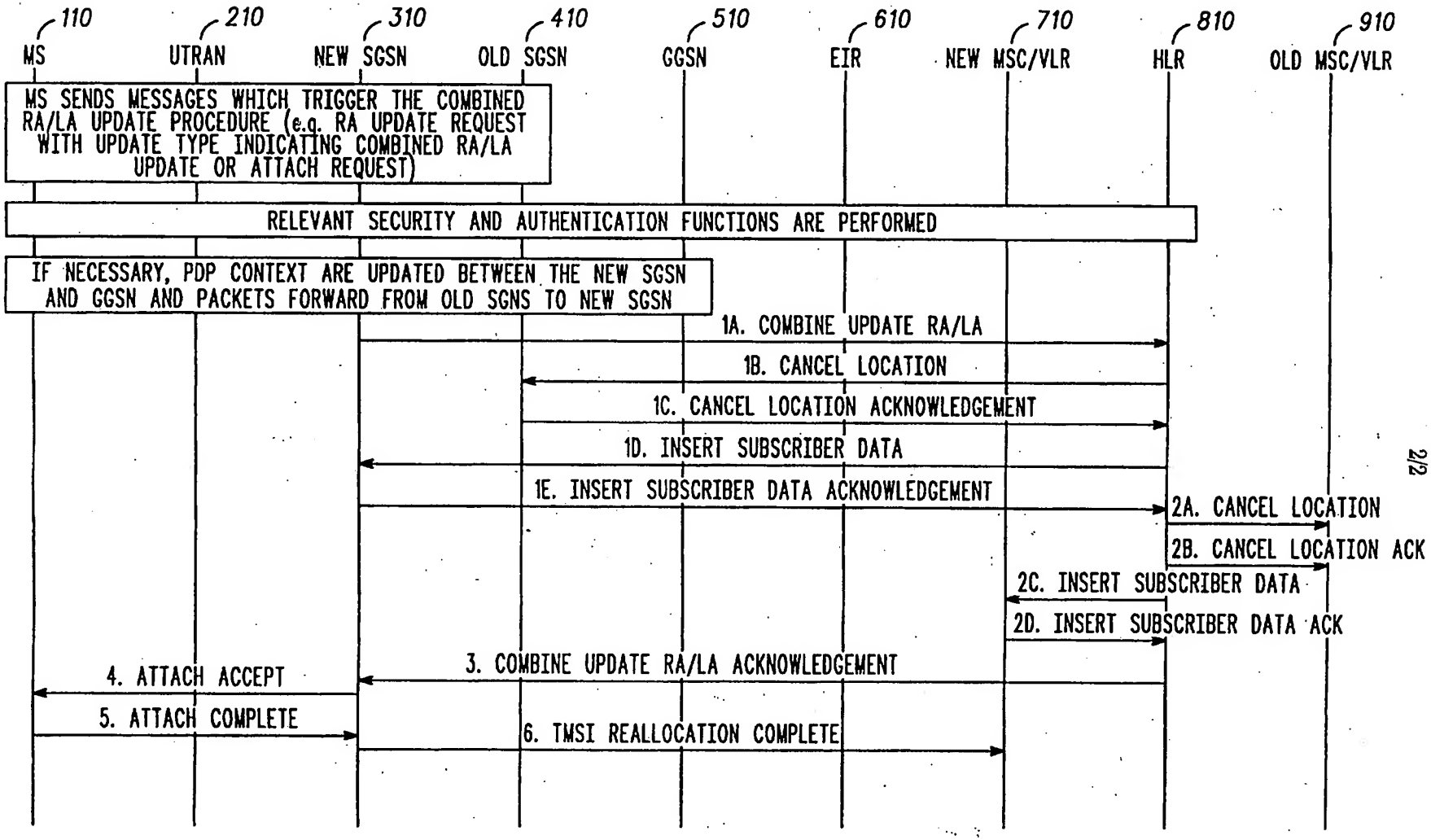
110
210
310
410
510
610
710
810
910
MS
UTRAN
NEW SGSN
OLD SGSN
GGSN
EIR
NEW MSC/VLR
HLR
OLD MSC/VLR
MS SENDS MESSAGES WHICH TRIGGER THE COMBINED RA/LA UPDATE PROCEDURE (e.g. RA UPDATE REQUEST WITH UPDATE TYPE INDICATING COMBINED RA/LA UPDATE OR ATTACH REQUEST)
RELEVANT SECURITY AND AUTHENTICATION FUNCTIONS ARE PERFORMED
IF NECESSARY, PDP CONTEXT ARE UPDATED BETWEEN THE NEW SGSN AND GGSN AND PACKETS FORWARD FROM OLD SGNS TO NEW SGSN
1A. COMBINE UPDATE RA/LA
1B. CANCEL LOCATION
1C. CANCEL LOCATION ACKNOWLEDGEMENT
1D. INSERT SUBSCRIBER DATA
1E. INSERT SUBSCRIBER DATA ACKNOWLEDGEMENT
2A. CANCEL LOCATION
2B. CANCEL LOCATION ACK
2C. INSERT SUBSCRIBER DATA
2D. INSERT SUBSCRIBER DATA ACK
3. COMBINE UPDATE RA/LA ACKNOWLEDGEMENT
4. ATTACH ACCEPT
5. ATTACH COMPLETE
6. TMSI REALLOCATION COMPLETE

FIG. 2

CELLULAR COMMUNICATIONS SYSTEM AND METHOD FOR SIGNALLING THEREIN

Field of the Invention

This invention relates to signalling in cellular communications networks, and particularly to Mobility Management Location Area (LA) Update and Routing Area (RA) Update message signalling in cellular networks such as Generalized Packet Radio Service (GPRS) systems and Universal Mobile Telecommunication Systems (UMTS) systems.

Background of the Invention

In the field of this invention it is known that current standardized Combined Location Area and Routing Area Update message sequences require that the Location Area Update and Routing Area Update be done separately.

The combined RA/LA update in GPRS occurs very often during the course of a mobile session, firstly in the GPRS/IMSI (International Mobile Subscriber Identity, or International Mobile Station Identity) attach procedure, and thereafter periodically while a GPRS- and IMSI-attached Mobile Station (MS) is active.

However, this approach has the disadvantage(s) that the current combined RA/LA update is performed serially, i.e., a routing area update followed by a location area

update. This means the Home Location Register (HLR) is updated twice, once by the Serving GPRS Service Node (SGSN) during the RA update, and then by the Mobile Switching Centre (MSC) or Visitor Location Register (VLR) during the LA update. Moreover, the SGSN has to send two location updates, one to the HLR during the RA update, and the second to the MSC/VLR.

This generates redundant signalling, which is repeated regularly throughout the course of a MS session, which causes unnecessary delays as an MS moves between RAs and LAs, and may increase call set-up times.

It is an object of the present invention to provide a method for signalling in a cellular communications system wherein the abovementioned disadvantage(s) may be alleviated.

Statement of Invention

In accordance with a first aspect of the present invention there is provided a method for signalling in a cellular communications system as claimed in claim 1.

In accordance with a second aspect of the present invention there is provided a cellular communications system as claimed in claim 4.

In accordance with a third aspect of the present invention there is provided an SGSN for use in a cellular communications system as claimed in claim 7.

In accordance with a fourth aspect of the present invention there is provided an MSC/VLR for use in a cellular communications system as claimed in claim 8.

In accordance with a fifth aspect of the present invention there is provided an HLR for use in a cellular communications system as claimed in claim 10.

Brief Description of the Drawings

One method for signalling in a cellular communications system incorporating the present invention will now be described, by way of example only, with reference to the accompanying drawing(s), in which:

FIG. 1 shows a diagram illustrating standard combined GPRS/IMSI attach procedure; and

FIG. 2 shows a diagram illustrating a novel combined GPRS/IMSI attach procedure based on the present invention.

Description of Preferred Embodiment

Referring firstly to FIG. 1, in a standard GPRS system, the combined GPRS/IMSI attach procedure is conducted in the following steps:

1 The combined GPRS/IMSI attach procedure is initiated by a Mobile Station (MS) 100 in a Universal Mobile Telecommunications Systems / Universal Terrestrial Radio Access (UMTS/UTRA or UTRAN) system 200 sending an Attach Request message to a new SGSN 300.

2 The new SGSN 300 then sends an Identification Request message (step 2a) to the old SGSN 400, which responds by sending an Identification Response message (step 2b) to the new SGSN 300.

3 The new SGSN 300 then sends an Identity Request message (step 3a) to the MS 100, which responds by sending an Identity Response message (step 3b) to the new SGSN 300.

4 Authentication messages are then exchanged between the MS 100 and the new SGSN 200, and between the new SGSN 200 and HLR 800.

5 International Mobile Equipment Identity (IMEI) Check messages are then exchanged between the MS 100 and the new SGSN 200, and between the new SGSN 200 and Equipment Identity Register (EIR) 600.

6 The new SGSN 300 then sends an Update Location message (step 6a) to the HLR 800, which then sends a Cancel Location message (step 6b) to the old SGSN 400, which responds by sending a Cancel Location Acknowledge (Ack) message (step 6c) to the HLR 800. The HLR 800 then sends an Insert Subscriber Data message (step 6d) to the new SGSN 300, which

responds by sending an Insert Subscriber Data Ack message (step 6e) to the HLR 800, which responds by sending an Update Location Ack message (step 6f) to the new SGSN 300.

7 The new SGSN 300 then sends a Location Update Request message (step 7a) to new MSC/VLR 700. The new MSC/VLR 700 then sends an Update Location message (step 7b) to the HLR 800, which in turn sends a Cancel Location message (step 7c) to the old MSC/VLR 900, which responds by sending a Cancel Location Ack message (step 7d) to the HLR 800. The HLR 800 then sends an Insert Subscriber Data message (step 7e) to the new MSC/VLR 700, which responds by sending an Insert Subscriber Data Ack message (step 7f) to the HLR 800. The HLR 800 then sends an Update Location Ack message (step 7g) to the new MSC/VLR 700. The new MSC/VLR 700 then sends a Location Update Accept message (step 7h) to the new SGSN 300.

8 The new SGSN 300 then sends an Attach Accept message to the MS 100.

9 The MS 100 then sends an Attach Complete message (step 9) to the new SGSN 300.

10 The new SGSN 300 finally sends a Temporary Mobile Station Identity (TMSI) Reallocation Complete message (step 10) to the new MSC/VLR 700.

Such a message signalling procedure is described in the publication '3G TS 23.060' V3.3.1 (2000-05), 3rd

Generation Partnership Project, Technical Specification Group Services and System Aspects, General Packet Radio Service (GPRS), which publication is hereby incorporated herein by reference.

As will be explained in greater detail below, the proposed invention can be implemented by a simple software upgrade in the SGSN, MSC/VLR and HLR, in order to accommodate a more efficient message signalling sequence. The new sequence allows the RA and LA update to occur in parallel, and also allows a reduction in the number of signalling messages required. It should be noted that the upgrade does not negate the ability of the network to cope with signalling as is specified in current standards specifications. It may also be noted that this new message signalling sequence may only be applicable to Class A MSs in GPRS systems and to mobiles operating in the equivalent PS/CS mode in UMTS systems.

Referring now to FIG. 2, in a GPRS system, an improved combined GPRS/IMSI attach procedure (in a GPRS system having an MS 110, a BSS 210, an upgraded new SGSN 310, an upgraded old SGSN 410, a GGSN 510, an EIR 610, an upgraded new MSC/VLR 710, an HLR 810 and an old MSC/VLR 910) is conducted by the following steps:

The new combined GPRS/IMSI attach procedure may be initiated by the MS 110 sending messages which trigger the combined RA/LA update procedure (e.g., RA update request with Update Type indicating combined RA/LA update, or Attach request). Relevant security and authentication functions are then performed.

1. a) The upgraded new SGSN 310 then sends a new, Combined Update LA/RA message to the HLR 810. This message is a combination of

- the standard Update Location (SGSN Number, SGSN Address, IMSI) from the new SGSN 310 to the HLR 810,
- the Location Update Request (new Location Area Identity (LAI), IMSI, SGSN Number, Location Update Type) from the new SGSN 310 to MSC/VLR 710, and
- the Update Location (IMSI, new VLR) from the MSC/VLR 710 to the HLR 810.

b)-e) the Cancel Location and Insert Subscriber Data message pairs progress as in standard GPRS message signalling (see steps 6b-6e of FIG. 1).

2. a) On receipt of the New Update Location message from the upgraded SGSN 310, the upgraded HLR 810 notes that the new MSC/VLR address is different from the old address it has in its database corresponding to the MS IMSI, and sends a Cancel Location message to the old MSC/VLR 910 as in standard GPRS message signalling (see step 7c of FIG. 1).

b) the Cancel Location Acknowledge from the old MSC/VLR 910 to the HLR 810 progresses as in standard GPRS message signalling (see step 7d of FIG. 1). The old MSC/VLR 910 therefore does not have to be upgraded.

c) the HLR 810 then sends an Insert Subscriber Data (IMSI, GSM subscriber data, SGSN Number, new LAI, Location Update Type) to the new MSC/VLR 710. This message contains the information in the standard Insert Subscriber Data message (IMSI, GSM subscriber data), as well as additional information that would normally be given to the new MSC/VLR in a Location Update Request from the SGSN.

d) the upgraded MSC/VLR 710 replies with a Insert Subscriber Data Acknowledge (IMSI, VLR TMSI). The addition of the VLR Temporary Mobile Station Identity (TMSI) to this Insert Subscriber Data Acknowledge allows another message to be removed, i.e., the Location Update Accept from the new MSC/VLR to the SGSN.

It should be noted that due to the fact that there was no initial Update Location message necessary from the new MSC/VLR 710 to the HLR 810, there is also no need for the Update Location Acknowledge message from the HLR 810 to the new MSC/VLR 710.

3. The Combined Update RA/LA Acknowledge message (VLR TMSI) from the HLR 710 to the new SGSN 310 combines the functionality of the standard Update Location Acknowledge and the standard Location Update Accept. The standard Update Location Acknowledge from the HLR 810 to the new SGSN 310 in the RA Update occurs after the Cancel Location Acknowledge from the new SGSN 310 to the HLR 810. The standard Location Update Accept from the MSC/VLR to the SGSN

occurs after the Update Location Acknowledge from the HLR to the MSC/VLR.

4)-6) occur as in standard GPRS message signalling (see steps 8-10 of FIG. 1).

It will be understood that the above described improved method for signalling in a cellular communications system described above provides the following advantages:

- This solution reduces the total number of signalling messages involved in a combined RA/LA update in GPRS as well as in a combined PS/CS attach in UMTS, by four messages. This, and the following results will also be applicable for subsequent implementations of these RA/LA updates in next generation networks.

- As the number of signalling messages is reduced, the time involved in these updates is also reduced.

- As routing area and location area updates are carried out in parallel rather than sequentially as in prior solutions, the time involved in these updates is reduced further.

- The call set up time may also be reduced as the updates may need to be performed during call initiation.

- There may be advantages due to combining the location data in the HLR from routing area updates

and location area updates, as a routing area is a subset of a location area.

- There is less need to transmit the mobile's IMSI between the entities in the core network, since the update messages are combined. This method is therefore more secure.

Claims

1. A method for message signalling in a cellular communications system, comprising:

sending a Combined Update RA/LA message from a new SGSN to an HLR;

sending a Cancel Location message from the HLR to an old SGSN, and in acknowledgement thereof sending a Cancel Location Acknowledge message from the old SGSN to the HLR;

sending an Insert Subscriber Data message from the HLR to the new SGSN, and in acknowledgement thereof sending an Insert Subscriber Data Acknowledge message from the new SGSN to the HLR;

sending a Cancel Location message from the HLR to an old MSC/VLR, and in acknowledgement thereof sending a Cancel Location Acknowledge message from the old MSC/VLR to the HLR;

sending an Insert Subscriber Data message from the HLR to a new MSC/VLR, and in acknowledgement thereof sending an Insert Subscriber Data Acknowledge message from the new MSC/VLR to the HLR;

sending a Combined Update RA/LA Acknowledge message from the HLR to the new SGSN; and

sending an Attach Accept message from the new SGSN to an MS, and sending an Attach Complete message from the MS to the new SGSN; and sending a TMSI Reallocation Complete message from the new SGSN to the new MSC/VLR,

wherein

the Combined Update RA/LA message contains information of: new LAI; IMSI; SGSN Number; Location Update Type; and new VLR; and

the Insert Subscriber Data message from the HLR to the new MSC/VLR contains information of: new LAI; IMSI; SGSN Number; Location Update Type.

2. The method of claim 1 wherein the Insert Subscriber Data Acknowledge message from the new MSC/VLR to the HLR contains information of: IMSI; and VLR TMSI.

3. The method of claim 1 or 2 wherein the cellular communications system is a GPRS system or a UMTS system.

4. A cellular communications system, comprising:

an MS;

a plurality of SGSNs;

a plurality of MSC/VLRs;

an HLR;

means for sending a Combined Update RA/LA message from a new SGSN of the plurality of SGSNs to the HLR;

means for sending a Cancel Location message from the HLR to an old SGSN of the plurality of SGSNs, and in acknowledgement thereof sending a Cancel Location Acknowledge message from the old SGSN to the HLR;

means for sending an Insert Subscriber Data message from the HLR to the new SGSN, and in acknowledgement thereof sending an Insert Subscriber Data Acknowledge message from the new SGSN to the HLR;

means for sending a Cancel Location message from the HLR to an old MSC/VLR of the plurality of MSC/VLRs, and in acknowledgement thereof sending a Cancel Location Acknowledge message from the old MSC/VLR to the HLR;

means for sending an Insert Subscriber Data message from the HLR to a new MSC/VLR of the plurality of MSC/VLRs, and in acknowledgement thereof sending an Insert Subscriber Data Acknowledge message from the new MSC/VLR to the HLR;

means for sending a Combined Update RA/LA Acknowledge message from the HLR to the new SGSN; and

means for sending an Attach Accept message from the new SGSN to the MS, and sending an Attach Complete message from the MS to the new SGSN; and sending a TMSI Reallocation Complete message from the new SGSN to the new MSC/VLR,

wherein

the Combined Update RA/LA message contains information of: new LAI; IMSI; SGSN Number; Location Update Type; and new VLR; and

the Insert Subscriber Data message from the HLR to the new MSC/VLR contains information of: new LAI; IMSI; SGSN Number; Location Update Type.

5. The system of claim 4 wherein the Insert Subscriber Data Acknowledge message from the new MSC/VLR to the HLR contains information of: IMSI; and VLR TMSI.

6. The system of claim 4 or 5 wherein the cellular communications system is a GPRS system or a UMTS system.

7. An SGSN for use in a cellular communications system, the SGSN comprising:

means for sending a Combined Update RA/LA message from the SGSN to an HLR;

means for receiving a Cancel Location message from the HLR, and in acknowledgement thereof sending a Cancel Location Acknowledge message to the HLR;

means for receiving an Insert Subscriber Data message from the HLR, and in acknowledgement thereof sending an Insert Subscriber Data Acknowledge message to the HLR;

means for receiving a Combined Update RA/LA Acknowledge message from the HLR;

means for sending an Attach Accept message to an MS, and receiving an Attach Complete message from the MS; and

means for sending a TMSI Reallocation Complete message to an MSC/VLR,

wherein

the Combined Update RA/LA message contains information of: new LAI; IMSI; SGSN Number; Location Update Type; and new VLR.

8. An MSC/VLR for use in a cellular communications system, the MSC/VLR comprising:

means for receiving a Cancel Location message from an HLR, and in acknowledgement thereof sending a Cancel Location Acknowledge message from an old MSC/VLR to the HLR;

means for receiving an Insert Subscriber Data message from the HLR, and in acknowledgement

thereof sending an Insert Subscriber Data Acknowledge message to the HLR;

means for receiving a TMSI Reallocation Complete message from a new SGSN,

wherein

the Insert Subscriber Data message from the HLR contains information of: new LAI; IMSI; SGSN Number; Location Update Type.

9. The MSC/VLR of claim 8 wherein the Insert Subscriber Data Acknowledge message to the HLR contains information of: IMSI; and VLR TMSI.

10. An HLR for use in a cellular communications system, the HLR comprising:

means for receiving a Combined Update RA/LA message from a new SGSN;

means for sending a Cancel Location message to an old SGSN, and in acknowledgement thereof receiving a Cancel Location Acknowledge message from the old SGSN;

means for sending an Insert Subscriber Data message from the HLR to the new SGSN, and in acknowledgement thereof receiving an Insert Subscriber Data Acknowledge message from the new SGSN;

means for sending a Cancel Location message to an old MSC/VLR, and in acknowledgement thereof sending a Cancel Location Acknowledge message from the old MSC/VLR to the HLR;

means for sending an Insert Subscriber Data message to a new MSC/VLR, and in acknowledgement thereof

receiving an Insert Subscriber Data Acknowledge message from the new MSC/VLR; and

means for sending a Combined Update RA/LA Acknowledge message to the new SGSN;

wherein

the Insert Subscriber Data message to the new MSC/VLR contains information of: new LAI; IMSI; SGSN Number; Location Update Type.

11. The HLR of claim 10 wherein the Insert Subscriber Data Acknowledge message from the new MSC/VLR contains information of: IMSI; and VLR TMSI.

12. A computer program element comprising computer program code means for performing substantially the method of claim 1, 2 or 3.

13. A computer program element for an SGSN of a cellular communications system, comprising computer program code means for use in performing substantially the method of claim 1, 2 or 3.

14. A computer program element for an MSC/VLR of a cellular communications system, comprising computer program code means for use in performing substantially the method of claim 1, 2 or 3.

15. A computer program element for an HLR of a cellular communications system, comprising computer program code means for use in performing substantially the method of claim 1, 2 or 3.

16. The computer program product of any one of claims claim 12-15, embodied on a computer readable medium.

17. A method for signalling in a cellular communications system substantially as hereinbefore described with reference to FIG. 2 of the accompanying drawings.